

Randomized controlled trial of the effect of the Royal College of Radiologists' guidelines on general practitioners' referrals for radiographic examination

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SUMMARY

Background. The Royal College of Radiologists' guidelines aim to encourage more appropriate use of diagnostic radiology and so reduce the use of clinically unhelpful x-ray examinations.

Aim. The object of this study was to conduct a randomized controlled trial of the introduction of the guidelines into general practice.

Method. A total of 62 practices (170 general practitioners) referring patients to St George's Hospital, London for diagnostic radiology were randomly allocated into two groups. Guidelines were sent to the 30 practices in the intervention group. Radiological referral patterns were compared in both groups before and after the introduction of guidelines.

Results. Practices which had received guidelines requested significantly fewer examinations of the spine, and made a significantly higher proportion of requests which conformed to the guidelines compared with practices which had not received the guidelines. There were no significant differences in the proportion of forms giving physical findings or in the proportion of positive findings at radiology.

Conclusion. Introduction of guidelines can influence general practitioners' radiological referrals in the short term. Wider use of guidelines might help to reduce unnecessary irradiation of patients.

Keywords: recommendations and guidelines; doctors' compliance; referral patterns; radiography.

Introduction

THE Royal College of Radiologists' working party found that radiological referrals from 22 general practices fell after introduction of the Royal College of Radiologists' guidelines.^{1,2} Locally produced and agreed guidelines have similarly reduced general practitioners' radiological referrals.³⁻⁵ However, despite calls for the promotion of the Royal College of Radiologists' guidelines among general practitioners^{6,7} there have been no randomized studies of their use in general practice.⁸

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The Department of Clinical Radiology at St George's Hospital, London has offered general practitioners direct access to radiological services for over 15 years. In 1991 a pilot study of 598 general practitioner radiological referrals to St George's found that 35% were outside the guidelines.⁹ It was decided to introduce the Royal College of Radiologists' guidelines to local general practitioners as a randomized controlled trial to determine whether this had any effect on radiological referral patterns.

Method

The study group comprised 62 practices (170 general practitioners) who referred patients to the Department of Clinical Radiology during the first two weeks of the study. Practices were stratified by number of partners and number of radiographic examinations requested, and randomized into two groups. Thirty practices were in the intervention group and 32 in the control group. During a seven week period starting in April 1992 radiology request forms were collected when patients from these practices attended the department. Radiological guidelines and an introductory letter were then sent to each general practitioner in the intervention group of practices. After a three week interval request forms were collected from both groups for a further nine weeks. Requests for ultrasonography and contrast studies were excluded from the analysis.

Guidelines

The Royal College of Radiologists' guidelines are 40 pages long and contain much which is not relevant to general practice. Therefore, only those guidelines which referred to examinations of the chest, limbs and joints, and spine were selected as these comprise 84% of all radiographic examinations requested.² The guidelines were printed verbatim on two sides of a sheet of A4 paper which was then plasticized.

Conformity with the guidelines

Conformity was assessed by P O and J W who were unaware which practices had been sent the guidelines. Only radiological requests targeted in the guidelines were assessed. Each request with the clinical details given on the referral form was assessed for conformity with the guidelines. For example, a request for a chest radiological examination on a patient with cough and wheeze conformed to the guidelines. A request for a lumbar spine examination which merely stated 'backache' with no other details did not conform since the guidelines state that an examination is indicated if 'symptoms getting worse, or not resolving; neurological signs; or a history of trauma'.² The study did not assess whether the radiological request was clinically appropriate, but only whether the details on the referral form conformed with the guidelines.

Analysis

The number of radiographic examinations requested, the proportion of requests which conformed to the guidelines, the proportion of requests giving physical findings and the proportion of

radiographic examinations with relevant positive findings were compared in the intervention and control groups. Randomization and analysis were done by practice rather than by individual general practitioner since it could not be assumed that general practitioners in one practice were totally independent of each other. For each outcome measure the change between the initial period and the follow-up period was calculated for each practice. The mean change between baseline and follow up was then compared in the intervention and control groups.

Changes in proportions of requests per practice were compared using the Mann-Whitney *U* test. Only proportions based on four or more requests were included in the analysis. The number of requests per practice was transformed using log (number of requests + 1) prior to calculating the change between the initial period and follow up. This transformation normalized the data and stabilized the variances allowing student's *t*-tests to be used to compare change between the initial period and follow up in the intervention and control groups. The transformed differences approximate to the log of the ratio of the follow up to the initial number of referrals. The percentage change has been calculated as 100 (1 - 7/9 geometric mean), where the geometric mean is the antilog of the mean change after transformation. The confidence intervals for the geometric mean are the antilogs of the confidence intervals for the mean of the log transformed data. The addition of one in the log transformation will slightly underestimate the percentage change, but the effect is small and allows all the data to be used; 7/9 adjusts for the follow-up period being longer than the initial period. For ease of comparison between initial and follow-up periods the number of requests have been presented per four week period.

Results

A total of 1427 radiographic examinations were requested in the initial seven week period and 1509 in the nine week follow-up period. Altogether 2578 patients (mean age 47 years) were examined. The mean number of radiographic examinations per patient was 1.1. There were 165 patients (6.4%) who were aged less than 16 years, and there were 438 women (17.0%) of child bearing age (16-40 years). These percentages did not change significantly over the study period.

Of the 2936 requests 1018 (34.7%) were for an examination of limbs and joints, 990 (33.7%) for an examination of the chest, 710 (24.2%) spine, 84 (2.9%) sinuses, 70 (2.4%) abdomen, 34 (1.2%) skull and 30 (1.0%) were miscellaneous requests for other radiological examinations.

Number of radiographic examinations requested

The mean number of spine examinations requested per practice fell significantly in the intervention group compared with the control group between the two periods ($P < 0.05$, Tables 1 and 2). There was

Table 2. Ratio of the number of examinations requested by practices in the intervention and control groups during the follow-up period.^a

Type of examination requested	Ratio (intervention: control) (95% CI)
Limbs and joints	0.98 (0.66 to 1.45)
Spine	0.69 (0.50 to 0.95) *
Chest	1.18 (0.90 to 1.52)
All requests	0.95 (0.68 to 1.32)

^aNumber of requests per four weeks in the follow-up period are expressed as a percentage of those in the initial period. CI = confidence interval. * $P < 0.05$ student *t*-test

no significant difference between the groups in the changes in the number of requests for examinations of chest, limbs and joints, or in the total number of examinations requested.

There was considerable variation between practices in the number of requests made. The number of requests per practice over four weeks ranged from one to 53 in the initial period, and zero to 60 in the follow-up period. There were also considerable differences between practices in the size of the changes over the study period, with 19 practices reducing their referral rates by over 50% while 16 actually increased their referral rates.

Conformity with the guidelines

The proportion of requests which conformed to the guidelines increased significantly in practices given the guidelines ($P < 0.01$, Table 3). There was no significant improvement in the conformity of requests for examinations of limbs and joints, chests and spines when considered separately. However, the number of intervention practices requesting four or more examinations in both periods was small, especially for spine examinations.

Radiological request forms giving physical findings

The mean percentage of forms per practice giving physical finding fell slightly in both groups over the course of the study, (from 60.8% to 58.2% in the intervention group and from 67.2% to 59.5% in the control group), but the differences between the two groups were not significant.

Relevant positive findings at radiology

The mean rate of relevant positive findings at radiology was 44.4% and increased slightly in both groups (from 43.0% to 45.4% in the intervention group and from 40.6% to 48.8% in the control group), but the differences between the two groups were not significant.

Table 1. Number of examinations requested per practice before and after introducing the guidelines.

Type of examination requested	Intervention group (n=30)			Control group (n=32)		
	Mean no. (SD) of requests per practice over 4 weeks		Geometric mean of follow up as % of initial value (95% CI)	Mean no. (SD) of requests per practice over 4 weeks		Geometric mean of follow up as % of initial value (95% CI)
	Initial period	Follow-up period		Initial period	Follow-up period	
Limbs and joints	4.0 (4.6)	2.7 (2.6)	72 (52 to 98)	5.5 (6.3)	4.4 (6.6)	73 (57 to 94)
Spine	3.3 (3.7)	1.7 (1.9)	56 (44 to 72)	3.5 (3.5)	3.1 (3.5)	82 (66 to 108) *
Chest	3.9 (4.4)	3.3 (3.8)	82 (66 to 102)	5.1 (5.9)	3.8 (4.9)	70 (60 to 82)
All requests	12.3 (13.6)	8.1 (8.3)	65 (50 to 75)	15.3 (15.4)	12.2 (15.4)	68 (56 to 84)

n = number of practices in group. SD = standard deviation. CI = confidence interval. * $P < 0.05$ student *t*-test.

Table 3. Percentage of radiology requests per practice which conformed to the guidelines.

Type of examination requested	Mean % of radiology requests per practice conforming to guidelines (no. of practices) ^a					
	Intervention group			Control group		
	Initial period	Follow-up period	Difference	Initial period	Follow-up period	Difference
Limbs and joints	85.7	88.8	3.1 (10)	87.2	83.6	-3.6 (15)
Chest	92.2	92.9	0.7 (13)	93.5	90.6	-2.9 (13)
Spine	39.5	44.8	5.3 (7)	34.7	33.5	-1.2 (14)
All requests	73.3	83.5	10.2 (22)**	74.9	73.2	-1.7 (21)

^aOnly practices where more than four radiographic requests were made in both periods are included for each type of examination. ** $P < 0.01$ Mann-Whitney *U* test.

Discussion

The introduction of radiological guidelines to general practitioners was associated with a fall in the number of spine examinations requested and an increase in the proportion of all requests which conformed to the guidelines. The Royal College of Radiologists' working party found a 17.5% fall in spine examinations after guidelines were introduced.¹ One reason may be that guidelines for examinations of the spine were quite specific. As in a previous study,⁶ over half the lumbar spine radiographs requested by general practitioners were outside the guidelines (data before spine examinations combined). It is likely that opportunity for improvement may be greater where more initial referrals are outside the guidelines.

There were no significant changes in the number of requests for examination of limbs and joints and the chest. This may be because the guidelines for these were less specific. Thus, over 85% of requests for limb and joint radiography and over 90% of requests for chest radiography conformed with the guidelines even before they were introduced. The problem of this lack of specificity of the guidelines was shown most clearly in analysis of requests for chest radiography where the commonest indication was 'cough'.⁹ Although a cough may be a symptom of an upper respiratory tract infection for which the guidelines state chest radiography is not indicated, these requests all had to be accepted as conforming with the guidelines.

While practices receiving guidelines made fewer requests for radiology overall, there was a similar reduction in requests from practices in the control group. This may have been partly a result of seasonal variation. This highlights the need for randomized controlled trials in this field involving many practices to avoid the temptation to attribute temporal changes to the intervention.⁸

There was a wide variation between practices in the number of radiological examinations requested which could only partly be explained by the number of doctors in a practice. Mills and Reilly similarly found considerable variation in radiological referral rates both between general practitioners and between practices.¹⁰ Such variation supports the suggestion that at least 20% of radiographic examinations currently carried out in hospitals in the United Kingdom are clinically unhelpful.¹¹⁻¹³ Unnecessary radiography may contribute between 100 and 250 annual deaths from cancer in the UK.¹⁴ Improved compliance with guidelines should lead to a substantial reduction in the use of hospital radiological services by general practitioners.^{1,7}

The Royal College of Radiologists' working party predicted that the guidelines would only be effective if their use was supported by monitoring and review of referral practice.^{1,7} Although in the present study there was no feedback, the introduction of guidelines was associated with changes in referral patterns in the short term. Further research is needed to see if these differences

persist over a longer period.^{1,4} However, it is likely that feedback would reinforce the effect of guidelines.⁷ Winkens and colleagues found that feedback on diagnostic requests exerted a strong influence on general practitioner request behaviour.¹⁵

The introduction of guidelines did not increase the proportion of request forms giving physical findings, despite the fact that certain physical findings, for example point tenderness on palpation of a possible fracture, were indications for radiography. The Royal College of General Practitioners and Royal College of Radiologists' joint working party stated that a request for a radiological examination was equivalent to a request for a clinical consultation.¹⁶ Full history and clinical findings should be provided.² General practitioners need to be aware of the importance of giving physical findings on radiology referral forms.^{17,18}

The mean rate of relevant positive findings at radiology was 44% and was not significantly different between intervention and control groups. This rate is comparable to previous studies in general practice.^{10,19} Although in hospital practice adherence to guidelines for skull examination has been found to increase the proportion of positive findings at radiology,²⁰ many radiographic requests in general practice are done to exclude rather than confirm abnormality.²¹

This preliminary study lends support to previous recommendations^{1,3,4} that guidelines for radiological referral be introduced and accepted as general practice policy just as they have been in hospital practice.⁷ Guidelines for use in general practice should be modified to make them more precise and appropriate to primary care.⁵ Guidelines for chest and joint radiography could be made more specific.²² Also, some guidelines suggest that examinations of the sinuses, heel and coccyx are rarely indicated in general practice.^{3,4,22} In the present study this might have avoided 84 sinus, 24 heel and three coccyx radiographs. In addition, continued monitoring of general practice radiology requests with regular review and updating of guidelines has been recommended.^{1,4}

It is recognized that general practitioners use direct access to diagnostic radiology responsibly.^{1,18} Their referral behaviour can be enhanced by the introduction of guidelines.^{1,3,4} Introduction and wider use of radiological guidelines by general practitioners, with audit and peer review, would reduce inappropriate referrals and thus reduce unnecessary irradiation of patients.

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Corrigendum — Health checks

In the editorial by David Mant (Health checks — time to check out? *Br J Gen Pract* 1994; **44**: 51-52) reference 11 was incorrect. The reference should have read:

Rose G. *Strategy for prevention*. Oxford University Press, 1992.

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